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(54) STRAPPING

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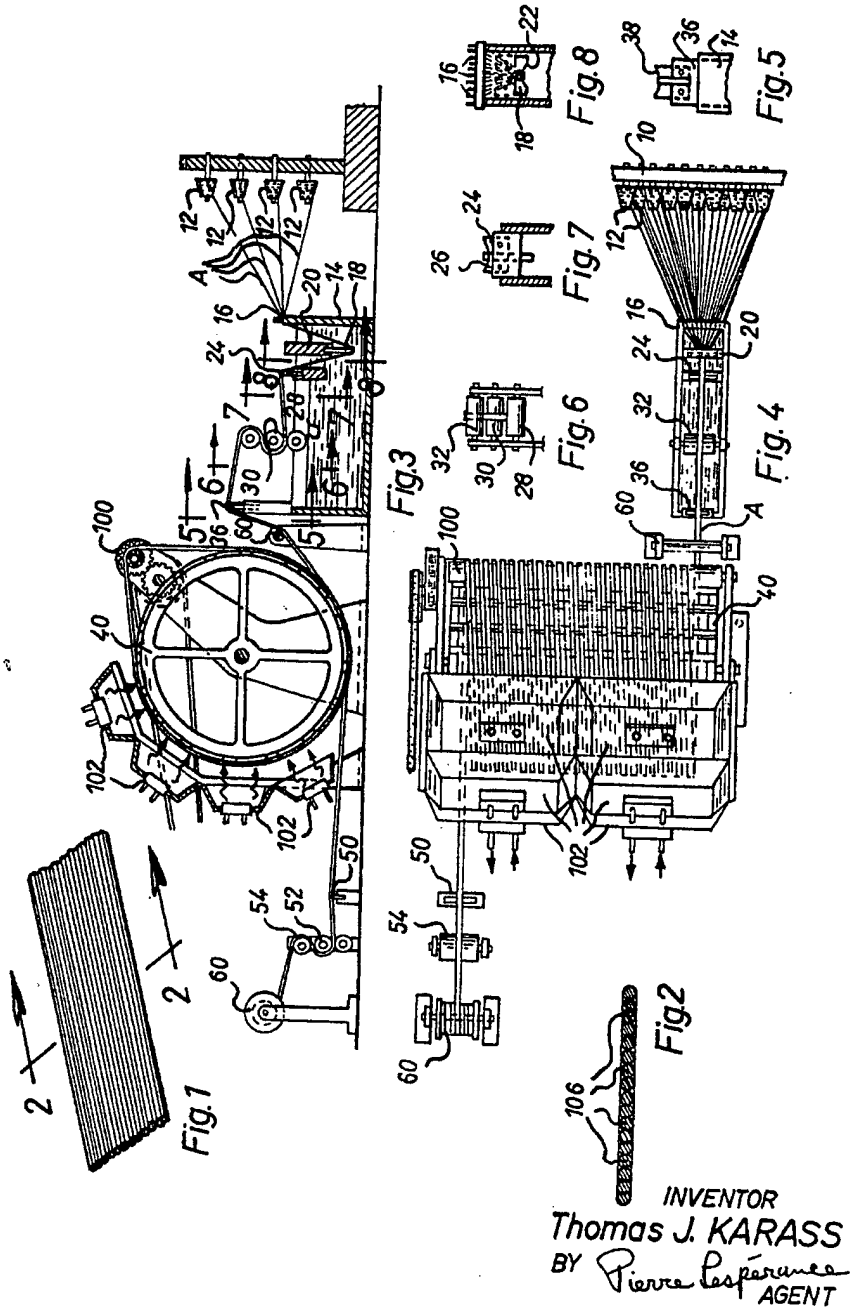

This invention relates to tapes or straps formed of individual strands or yarns bonded together in parallel relationship in a single layer.

In the prior art, there are various types of tapes or straps made of individual strands of material, which find use as a strapping in the packaging industry, as a substitute for metal bands. Such tapes have many advantages over metal strapping but to compete they must exhibit the following combination of properties:

(a) sufficient flexibility so that they can be bent around a corner readily;

(b) sufficient stiffness to enable them to be fed under a pallet or through a slot in an automatic packaging machine;

(c) a unity of structure so that the individual cords do not separate in handling, packaging and shipment;

(d) light weight and high strength; and

(e) a sufficient roughness or friction of surface to prevent slippage within a seal.

The prior art teaches the production of such tapes by joining together individual strands or yarns through adhesives such as polyvinyl alcohol, etc. The products thus produced have been shown to possess very good properties. However, with the present invention, applicant has developed an improved tape having greater strength characteristics, and which also have greater resistance to abrasion, by employing a plurality of individual yarns bonded together, in a side-by-side relationship, using an adhesive formed by co-polymerizing two or more of the monomers selected from acrylonitrile, butadiene, butyl acrylate, butyl methacrylate, dibutyl maleate, di (2-ethylhexyl) maleate, dioctyl maleate, divinylbenzene, ethyl acrylate, ethylene, 2-ethylhexyl acrylate, ethyl methacrylate, isobutyl acrylate, methacrylic acid, methyl acrylate, methyl methacrylate, methyl styrene, propyl acrylate, propylene, styrene, vinyl acetate, vinyl butyrate, vinyl chloride and vinylidene chloride.

The tape or strap products of the present invention, as

previously mentioned, are made from individual strands or yarns which are adhesively secured together. The strands or yarns which may be employed are preferably of the polyester type. However, other individual strands or yarns, such as those made from "nylon", polyethylene, polypropylene and similar synthetic resin fibre yarns, may be employed.

It is preferred that all of the individual yarns making up the tape be of substantially the same denier, so as to form a tape having a substantially uniform thickness. However, variations in the thickness of the yarns may also be employed should a product of that nature be desired.

The polyester or similar yarns used in the manufacture of the products, may have a denier ranging from about 200 to 60,000, and may be either single or plied yarns having twist factors from 0 upwards, e.g. $2\frac{1}{2}$ - 9, and from 9 - 14 twists per inch. Particularly preferred as material for forming the tape of the present invention is polyester yarn, which may be of different grades, e.g. tire cord grade.

The products of the present invention may be produced using the process and apparatus described in Canadian Patent 544,703. Briefly summarized, the method of that patent includes the steps of feeding from a supply source a plurality of continuous threads of fibrous material, aligning said threads in side-by-side parallel relationship and passing them through a bath of a water solution of a synthetic resin which is flexible when dry, while in the bath continuously and progressively bringing said threads together weftwise to parallel touching relationship by sliding lateral pressure and under constant longitudinal tension, then while maintaining the thus formed single ply tape under said longitudinal tension, subjecting it to additional rolling transaxial pressure to compact said tape to substantially uniform width and to expel excess adhesive, and drying said tape while constantly maintaining said longitudinal tension.

The apparatus disclosed in that patent includes means for feeding the plurality of individual threads, means for passing the individual threads over an adhesive bath to coat the thread with an

adhesive, means for progressively bringing the individual threads together into a parallel relationship with the threads lying side-by-side, means for subjecting the tape to transverse pressure and means for creating longitudinal or axial tension on the threads. In the apparatus shown in the patent, the aligned threads are rotated over a pair of spaced-apart drums, the drums being adjustable to permit the desired tension to be placed on the tape, as described in greater detail hereinafter.

Depending on a particular type of yarn material being employed, and the adhesive which is used, as selected from the above group, the process and apparatus described in Canadian Patent 544,703 may be modified to include a source of heat in order to expedite the setting and curing of the adhesive.

The particular type of heater apparatus used is not critical and either electrical or gas heaters, for example, may be employed. The degree of heat required depends on the particular adhesive and, in general, will be enough to set and cure the adhesive in a desired period of time.

The application of heat to the tape, when using for example polyester yarn with a compatible adhesive, also has the advantage of causing the polyester yarn to shrink, thus "heat setting" the product.

The adhesive used may be in various forms, although aqueous and non-aqueous emulsions and dispersions of the above monomers, co-polymerized, and with or without post addition of monomeric or polymeric plasticizers, may be used. The method of application of the adhesive composition may be by either aqueous or solvent phase deposition of the co-polymer to the yarns.

The amount of adhesive employed to coat the individual strands or yarns of the material forming the tape is not critical and will depend on the actual material being used. An amount, calculated on the basis of a dry weight pick-up, of between 15% and 50%, has been found to be satisfactory, desirably 33% to 40%.

In the products of the present invention, the number of individual strands employed in any given product will vary according to different factors, for example with the denier of the individual yarns,

the width of the product desired, strength characteristics, etc. Typical products of the present invention include tape, twine or strapping, having a width ranging up to 3 inches or more, with the denier of the individual yarns being within the previously-mentioned range. In this case the twine products may be made having as few as two yarns or strands adhesively secured together.

It will be understood that in describing the various monomers which may be used to form the co-polymeric adhesive, that the terms employed are meant to denote such compounds containing a sufficient amount of curing agent. The choice of the curing agent is within the skill of those skilled in the art.

The present invention is also illustrated in conjunction with the attached drawings, in which:

Figure 1 is a diagrammatic view of a section of tape formed by the present invention;

Figure 2 is a cross-sectional view of the tape portion shown in Figure 1;

Figure 3 is a diagrammatic elevational view mainly in section of an apparatus by means of which the method may be carried out;

Figure 4 is a plan view of the apparatus shown in Figure 3;

Figure 5 is an enlarged detail view along the line 5-5 of Figure 3, showing a strand guide plate;

Figure 6 is an enlarged detail view along the line 6-6 of Figure 3 showing the series of pressure rollers;

Figure 7 is an enlarged detail view located along the line 7-7 of Figure 3 showing a further strand guide plate; and

Figure 8 is an enlarged detail view along the line 8-8 of Figure 3 showing the initial strand guide plate.

In the drawing, reference numeral 10 denotes a supply creel mounting bobbins 12 which supply individual yarns of, for example, polyester material. Strands "A" are led to an adhesive containing tank, containing one of the above-mentioned adhesives. The ends are aligned in spaced-apart parallel relationship by a comb 16, where after they pass around a first guide plate 18 in the tank 14, mounted on a supporting frame

20. The recess 22 brings the strands together.

Thereafter, the strands are passed over a second guide plate 24 having arcuate concave guiding recesses 26, whereby the individual strands of yarns are compacted. The product is then passed between pressure rollers 28, 30, and 32, which are freely mounted and which act to further compact the partially finished product and expel the excess adhesive. The product is then fed over a third guide plate 36 with arcuate guiding recesses 38 and thereafter on to a main drying drum 40. A tension member 60 is mounted between the drum 40 and the guide 36.

The tape product is fed and maintained in spaced-apart alignment on the rotating drum 40, driven by suitable means, as for example, a further drum 100. The drum 100 also provides a means for placing a drive tension on to the products as they rotate.

Mounted adjacent the drum 40 on one side thereof are a plurality of heating units designated by reference numeral 102. Each unit may be either gas or electrically heated whereby the heat is downwardly directed on to the tape product as it passes over the drum 40. The heating units 102, as shown in the drawing, are each capable of delivering the required amount of heat; in the case of the polyester material, the heating units 102 will deliver approximately 12,000 BTU (3,000 kilogram-calories) each. The amount of heat can be regulated by suitable means (not shown) depending on the product used.

After passing over the drum 40 a predetermined number of revolutions, the tape product is then passed between and over driven finishing rolls 50, 52, and 54. The finished product is then wound on to a suitable storage roll 50 mounted on a supporting frame. The product of the present invention is illustrated in Figures 1 and 2. As will be seen, it includes a plurality of individual yarns 106, aligned in a side-by-side relationship and adhesively secured together by means of the particular adhesive previously described.

EXAMPLE 1

This example demonstrates the manufacture of polyester tapes suitable for strapping purposes.

The apparatus and process disclosed in applicant's earlier

Canadian Patent 544,703 was employed, with the modification that the main drum over which the wet adhesive-coated polyester tape was passed, was provided with heating elements spaced from the drum and providing an equivalent of about 12,000 BTU (3,000 kilogram-calories) heat. The heating units spaced from the drum were arranged to cover approximately 1/2 of the drum surface in a direction transaxial to the direction of movement of the tape.

Thirty-two individual strands of medium twist polyester yarn of tire cord grade were fed separately into a bath of adhesive, where the strands were individually coated. The bath consisted of an adhesive designated in the trade as "Co-polymer 239 V 30" produced by the Stein Hall Company, which was a mixture of polyvinyl acetate co-polymers believed to be composed of acrylic and butyrate monomers produced by polymerizing the monomers under elevated temperatures and extreme pressure. The adhesives had a solids content of between about 53 to 56%, a viscosity of about 3,000 (plus or minus 300 CPS) - Brookfield 3/20 RPM/24°C a pH of about 4.5 (plus or minus 1.0) and a weight of approximately 10.8 lbs. per gallon (1.08 gram per cubic centimeter). This adhesive has good water resistance.

The individual strands of the polyester yarn were then drawn together over a guiding element so as to form a single flat layer of the individual yarns. The resulting tape was then passed over the drum and its auxiliary drum, a plurality of times, and heated to a temperature sufficient to cure the adhesive and set the product. The rotation of the drum and the degree of heating the tape product was governed to cause the desired curing and setting of the adhesive by the time the tape was taken-off the drum. While being rotated, the tape was rotated under longitudinal axial tension, and with the specific yarn employed, and the type of adhesive, the shrinkage of the tape occurred, which provided a pre-shrunk product.

The rotating tape product was then compared to known tape products having similar yarns but with known prior art adhesives, and it was found that the product of the present invention possessed superior

strength properties.

EXAMPLE II

The procedures of Example 1 were repeated using this time medium twist polyester yarn with a similar adhesive of Example 1. The specific adhesive used was that marketed under the trade mark "TS-280" produced by Stein Hall Company. This adhesive has slightly different plasticity properties than the adhesive used in Example 1, and low temperature properties. After formation of the tape according to the procedures of Example 1, a product was produced which consisted of identical yarns joined together in a side-by-side relationship, the tape having a width of about 1.50 inches (3.81 cm), the indicated yarns a diameter of approximately .15 inches (.381 cm).

The strip of the tape thus formed was made into a sling, i.e. a portion of the product was cut, which had a length of approximately 5 feet (1.5 meter). This strip was tested to determine its load-bearing characteristics. It was found upon testing that the strip was capable of bearing a load of more than 6,000 kilos--far more than would have been expected when employing a similar tape made of the same yarns but using prior art adhesives.

The sling produced in the above Example II illustrates a further embodiment which has wide application for use as cargo slings. Cargo slings find wide application in the shipping trade, particularly now since the more modern practices involve the use of containers which in turn involve units and palletizing where slings find wide application.

It is not unusual, to save a great deal of time and labour, that the slings accompany the loads to their destination so that they will be in position for unloading. The trouble and cost to get such slings returned to the original shipper are obvious. Therefore, it is very important to produce slings as inexpensively as possible so that they can be regarded as a one-way item without undue cost to the shipper.

The product of Example II meets the above requirements. In greater detail, the yarn used in Example II has a tenacity of the order of 7 1/2 to 8 grams per denier; it will make a strap produced from ten ends in the above example of approximately 10,000 lbs. (4540 kilograms).

In the production of large denier products such as in Example II, a greater amount of heat is normally required to cure the adhesive than is the case when producing strapping from typical yarns of up to 3000 or 6000 denier, for example. This can be achieved in two ways:

(a) by increasing the number of heaters to 8 of approximately 12,000 B.T.U'S (3,000 kilogram-calories) each;

(b) By slowing down the speed of the strapping passing in front of the heaters from the 35-50 yds. per minute normally achieved when making a strap of 3/4" width from 1300 denier 2-ply material, to approximately 5 yards per minute when using the 60,000 denier material.

The apparatus illustrated in the drawings may also be modified by changing the shape of the ribs on the drum 100 as follows; interposed between the existing L-shaped ribs additional and higher ribs were introduced along the first part of the roller extending approximately one-half its length.

The products of the present invention may be formed into slings by any conventional means such as, for example, by looping the ends of a suitable length, the free ends being joined to the body of the strap in various methods which include stitching, binding, clamping with a sleeve or, by an adhesive, with our without some mechanical assistance.

If desired, the strapping so produced can also be protected from wear and tear and from other external effects by extruding a sheet of plastic around the strap in a manner similar to that used in coating a conventional clothesline.

While it is mentioned that the process and materials afford a strapping which can be made into an inexpensive sling which could be used on the basis of one-way utilization, it may of course be used several times and, in fact, could find applications in industry and materials handling generally as well as specifically for cargo.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED, ARE DEFINED AS FOLLOWS:-

1- A flexible weftless tape comprising a single ply of juxtaposed touching parallel threads of polyester yarn and an adhesive bonding said threads together, said adhesive being the cured product of an adhesive bath of a mixture of polyvinyl acetate co-polymers having a solids content of between 53 and 56%.

2- A weftless tape as claimed in claim 1, wherein the adhesive bath has a viscosity of about 3,000 CPS and a pH of about 4.5.

3- A weftless tape as claimed in claim 1 or 2, wherein the threads consist of medium twist polyester yarn of tire cord grade.

4- A flexible weftless tape comprising a single ply of juxtaposed touching parallel threads of twisted polyester yarn of tire cord grade and an adhesive bonding each thread to an adjacent one, said adhesive containing a mixture of polyvinyl acetate co-polymers and having, when not cured, a solids content of between about 53 and 56%.

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ABSTRACT OF THE DISCLOSURE

A flexible weftless tape for strapping consisting of a single ply of juxtaposed threads of synthetic resin, more particularly polyester yarn of tire cord grade, the threads adhered by an adhesive product especially selected for the yarn and containing a copolymer of acrylic and butyrate monomers produced by polymerizing the monomers under elevated temperature and at high pressure.